TESTING CONDITIONS FOR ENERGY STAR® MEASUREMENT SCANNERS

Prepared March 1997

In order to eliminate confusion and ensure consistency, the following protocol should be followed when measuring power for scanners under the ENERGY STAR® Office Equipment Program.

Outlined below are the ambient test conditions which should be established when performing the power measurement. These are necessary in order to ensure that outside factors do not affect the test results, and that test results can be reproduced later. A description of the specifications for testing equipment, as well as a discussion of testing issues, follow on the succeeding pages.

I. TEST CONDITIONS

Line Impedance:	< 0.25 ohm
Total Harmonic Distortion: (Voltage)	< 5%
Input AC Voltage:[1]	115 VAC RMS ± 5 V RMS
Input AC Frequency:[1]	60 Hz ± 3 Hz
Ambient Temperature:	25 deg. C ± 3 deg. C

II. TEST METHOD

Scanner Partners should measure and report the **average** energy consumption of their scanner products when in the low-power mode. Scanners should be tested in a configuration that is typical for their use and application to accurately record the low-power mode energy consumption.

To measure the average energy consumption, the scanner should be evaluated over a time period sufficiently long to include typical variations or surges in power (e.g., any cycling of the lamps). The recommended approach is to utilize a watt-hour meter, and measure the energy consumption in the low-power mode of the scanner over one (1) hour. This will allow Partners to capture any variations in power usage that occur during the low-power mode. Dividing the measured energy consumption by the time period over which it is measured will produce average Watts. While this approach will provide the most accurate results, it is not essential to follow this for scanners whose idle-mode energy consumption does not vary. For scanners with constant idle-mode energy consumption, Partners may choose to utilize a high quality watt-meter and take several measurements of instantaneous power.

---

[1] If products will be sold in Europe or Asia, testing should also be performed at the appropriate machine-rated voltage and frequency. For example, products destined for European markets might be tested at 230 V and 50 Hz. The logo should not be displayed on products shipped to Europe or Asia if the equipment does not meet the power requirements of the Program at the local voltage and frequency conditions.

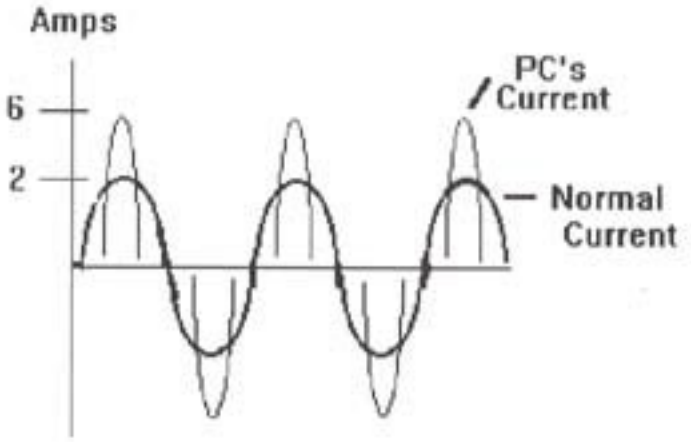
III. TESTING EQUIPMENT

The goal is to accurately measure the TRUE power consumption[2] of the scanner. This necessitates the use of a **True RMS** Watt-Meter or Watt-Hour Meter. There are many watt-meters and watt-hour meters to choose from, but Partners will need to exercise care in selecting an appropriate model. The following factors should be considered when purchasing a meter and setting up the actual test.

Crest Factor

It is important to understand that electronic equipment, such as scanners, typically draws current in a waveform different from typical sinusoidal current.[3] Figure 1 shows the typical current waveform for an electronic product containing a switching power supply. While virtually any meter can measure a standard current waveform, it is more difficult to select a meter when irregular current waveforms are involved.

Figure 1.



It is critical that the meter selected be capable of reading the current drawn by the scanner without causing internal peak distortion (i.e., clipping off the top of the current wave). This requires a review of the meter's crest factor,[4] and of the current ranges available on the meter. Better meters will have higher crest factors, and more choices of current ranges. When preparing the test, the first step should be to determine the peak current (amps) associated with the scanner being measured. This can be accomplished using an oscilloscope. A current range must be selected that will enable the meter to register the peak current. Specifically, the full scale value of the current

---

[2] True power is defined as (volts)x(amps)x(power factor), and is typically reported as Watts. Apparent Power is defined as (volts)x(amps) and is usually expressed in terms of VA or volt-amps. The power factor for equipment with switching power supplies is always less than 1.0; thus, true power is always less than apparent power.

[3] The crest factor for a sinusoidal 60 Hz current waveform is always 1.4. The crest factor for a current waveform associated with equipment containing a switching power supply will always be greater than 1.4 (though typically no higher than 8). The crest factor of a current waveform is defined as the ratio of the peak current (amps) to the RMS current (amps).

[4] The crest factor of a watt meter is often provided for both current and voltage. For current it is the ratio of the peak current to the RMS current in a specific current range. When only one crest factor is given, it is usually for current. An average True RMS Wattmeter has a crest factor in the range of 2:1 to 6:1.

range selected multiplied by the crest factor of the meter (for current) must be greater than the peak current reading from the oscilloscope. For example, if a meter has a crest factor of 4, and the current range is set on 3 amps, the meter can register current spikes of up to 12 amps. If measured peak current is only 6 amps, the meter would be satisfactory. However, if the current range is set too high in order to register peak current, then it may lose accuracy in measuring the non-peak current. Therefore, some delicate balancing is necessary. Again, with more current range choices and higher crest factors Partners will get better results.

Frequency Response

Another issue to consider when selecting a watt-meter is the frequency response rating of the meter. Electronic equipment that contains switching power supplies causes harmonics (odd harmonics typically up to the 21st). These harmonics must be accounted for in power measurement, or the Wattage consumption will be inaccurate. Accordingly, EPA recommends that Partners use meters that have a frequency response of at least 3 kHz. This will account for harmonics up to the 50th, and is recommended by IEC 555.

Resolution

When testing scanners whose energy consumption is close to the ENERGY STAR requirements, Partners will probably want a meter that can provide resolution of 0.1 W.

Accuracy

Another feature to consider is the resulting accuracy that can be achieved. Catalogues and specification sheets for watt-meters typically provide information on the accuracy of power readings that can be achieved at different range settings. When measuring a product that is very close to the ENERGY STAR specification (i.e., 12 watts), Partners will need to set up a test that will provide greater accuracy. For example, if the resulting accuracy for a watt-meter at the test settings is ± 0.5 W, then the measured energy consumption of the scanner should be 11.5 W in order to qualify for the ENERGY STAR label.

Calibration

Meters should be calibrated every year to maintain their accuracy.